MODEL SOLUTIONS TO IIT JEE 2008

PAPER 2

CODE - 0

PART I

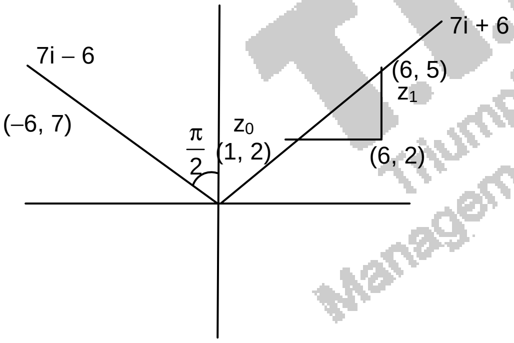
1	2	3	4	5	6	7	8	9	10
D	**D**	**B**	**B**	**D**	**D**	**A**	**C**	**A**	**C**

11	12	13	14	15	16	17	18	19
A	**B**	**C**	**A**	**A**	**B**	**B**	**D**	**C**

20	21	22
A – s	**A – r**	**A – p**
B – p, q	**B – q, s**	**B – s**
C – r	**C – r, s**	**C – q**
D – p, q, s	**D – p, r**	**D - q**

Section I

1.



$\Rightarrow$ (d)

2. $g(u) = 2\tan^{-1}(e^u) - \frac{\pi}{2}$

$\Rightarrow g'(u) = \frac{2}{1+e^{2u}}e^u \qquad g'(-u) \neq g'(u)$

Neither even nor odd

$\Rightarrow$ g(u) neither even nor odd

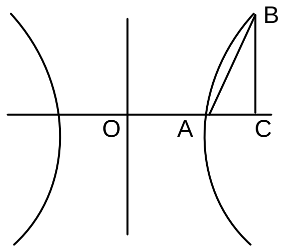
But $g'(u) > 0 \Rightarrow$ strictly increasing in $(-\infty, \infty)$

$\Rightarrow$ (d)

3. $\frac{\left(x-\sqrt{2}\right)^2}{4} - \frac{\left(y+\sqrt{2}\right)^2}{2} = 1$

$\Rightarrow a^2 = 4,\ e^2 = \frac{4+2}{4} = \frac{6}{4}$

$b^2 = 2$



Area ABC = $\frac{1}{2}$ AC $\times$ BC

$= \frac{1}{2}(ae-a) \times \frac{b^2}{a}$

$= \frac{1}{2}(e-1)b^2 = \frac{1}{2}\left(\frac{\sqrt{6}}{2}-1\right)2$

$$= \frac{1}{2}\left(\sqrt{6}-2\right) = \frac{\sqrt{6}}{2} - 1 = \frac{\sqrt{3}}{\sqrt{2}} - 1$$

$\Rightarrow$ (b)

4. $\int_0^{\pi/4} (y_1 - y_2)\,dx$

$$= \int_0^{\pi/4} \left(\sqrt{\frac{1+\sin x}{\cos x}} - \sqrt{\frac{1-\sin x}{\cos x}} \right) dx$$

$\sin x = \frac{2t}{1+t^2}$; $\cos x = \frac{1-t^2}{1+t^2}$;

$$= \int_0^{\sqrt{2}-1} \left(\sqrt{\frac{1+\frac{2t}{1+t^2}}{\frac{1-t^2}{1+t^2}}} - \sqrt{\frac{\left(1-\frac{2t}{1+t^2}\right)}{\left(\frac{1-t^2}{1+t^2}\right)}} \right) \frac{2dt}{1+t^2}$$

$$= \int_0^{\sqrt{2}-1} \frac{2t}{\left(1+t^2\right)\sqrt{1-t^2}} . 2dt$$

$$= \int_0^{\sqrt{2}-1} \frac{4t}{\left(1+t^2\right)\sqrt{1-t^2}} dt$$

$\Rightarrow$ (b)

5. Take $\alpha = \frac{\pi}{8}$, $\beta = \frac{\pi}{8}$, $\theta = \frac{\pi}{8}$

$\Rightarrow P\left(-\sin 0, -\cos\frac{\pi}{8}\right) = P\left(0, -\cos\frac{\pi}{8}\right)$

$Q\left(\cos 0, \sin\frac{\pi}{8}\right) = Q\left(1, \sin\frac{\pi}{8}\right)$

$R\left(\cos\frac{\pi}{8}, \sin 0\right) = R\left(\cos\frac{\pi}{8}, 0\right)$

$RQ \Rightarrow \frac{y - \sin\frac{\pi}{8}}{\sin\frac{\pi}{8}} = \frac{x-1}{1-\cos\frac{\pi}{8}}$

Substituting P in RQ $\Rightarrow$ P does not lie on RQ.

$PR \Rightarrow \frac{y-0}{\cos\frac{\pi}{8}} = \frac{x - \cos\frac{\pi}{8}}{\cos\frac{\pi}{8}}$

Substituting Q in PR $\Rightarrow$ Q does not lie on PR.

$PQ \Rightarrow \frac{y - \sin\frac{\pi}{8}}{\sin\frac{\pi}{8} + \cos\frac{\pi}{8}} = \frac{x-1}{1}$

Substituting R in PQ $\Rightarrow$ R does not lie on PQ.

$\Rightarrow$ P, Q, R are not collinear.

$\Rightarrow$ (d)

6. Let n(B only) = y

n(A $\cap$ B) = x

Then n(A only) = 4 – x

$\therefore P(A \cap B) = \frac{x}{10}$

$P(A) = \frac{4}{10}$ and $P(B) = \frac{x+y}{10}$

$\therefore P(A \cap B) = P(A)\,P(B)$

$\Rightarrow \frac{x}{10} = \frac{x+y}{10} \times \frac{4}{10}$

$\Rightarrow 3x = 2y$

$\Rightarrow$ (x + y) is a multiple of 5.

Only possible values are 5 and 10.

$\Rightarrow$ (d)

7. $\bar{a} = i$, $\bar{b} = \cos\alpha i + \sin\alpha j$, α acute

$\bar{r} = i\cos t + \sin t(\cos\alpha i + \sin\alpha j)$

$r = \sqrt{(\cos t + \sin t\cos\alpha)^2 + \sin^2 t\,\sin^2\alpha}$

$$= \sqrt{\cos^2 t + 2\cos t.\sin t.\cos\alpha + \sin^2 t.\cos^2\alpha + \sin^2 t.\sin^2\alpha}$$

$= \sqrt{1 + \cos\alpha.\sin 2t}$

Max $\Rightarrow \sqrt{1+\cos\alpha}$

$1 + \bar{a}.\bar{b} = 1 + \cos\alpha$

$\Rightarrow$ Max $= \sqrt{1+ab} = \left[1 + \left(\bar{a} - \bar{b}\right)\right]^{1/2}$

$\sin 2t = \sin\frac{\pi}{2} \Rightarrow t = \frac{\pi}{4}$

$\Rightarrow \hat{u} = \bar{a}.\cos\frac{\pi}{4} + \bar{b}.\sin\frac{\pi}{4} = \frac{1}{\sqrt{2}}\left(\bar{a} + \bar{b}\right)$

$= \frac{\bar{a} + \bar{b}}{\left|\bar{a} + \bar{b}\right|}$

$\therefore \Rightarrow$ (a)

8. $J = \int \frac{e^{3x}}{e^{4x} + e^{2x} + 1} dx$

$I = \int \frac{e^{3x} - e^{x}}{e^{4x} + e^{2x} + 1} dx$

$= \int \frac{e^{x} - e^{-x}}{e^{2x} + e^{-2x} + 1} dx$

$u = e^x + e^{-x} \Rightarrow du = (e^x - e^{-x})dx$

$u^2 = e^{2x} + e^{-2x} + 2$

$\int \frac{du}{u^2 - 1} = \frac{1}{2}\log\frac{u-1}{u+1} + 1$

$= \frac{1}{2}\,|\,og\left|\frac{e^x + e^{-x} - 1}{e^x + e^{-x} + 1}\right| + C$

$= \frac{1}{2}\log\left|\frac{e^{2x} - e^x + 1}{e^{2x} + e^x + 1}\right| + C$

$\Rightarrow$ (c)

9. $g(x) = \log_e f(x) \qquad f(x+1) = x\,.f(x)$

$f(x) = e^{g(x)}$

$f(x+1) = e^{g(x+1)} = x\,.\,e^{g(x)}$

$e^{g(x+1)-g(x)} = x$

$g(x+1) - g(x) = \log x$

$g(x+1) = g(x) + \log x$ — (1)

$g'(x+1) = g'(x) + \dfrac{1}{x}$

$g''(x+1) = g''(x) - \dfrac{1}{x^2}$ — (2)

$x+1 = N + \dfrac{1}{2} \Rightarrow x = N - \dfrac{1}{2}$

$\therefore$ (1) $\Rightarrow g''\left(N+\dfrac{1}{2}\right) - g''\left(N-\dfrac{1}{2}\right) = \dfrac{-1}{\left(N-\dfrac{1}{2}\right)^2}$

$$\Sigma = \frac{-1}{\left(1-\frac{1}{2}\right)^2} - \frac{1}{\left(2-\frac{1}{2}\right)^2} - \frac{1}{\left(3-\frac{1}{2}\right)^2} - \ldots\ldots$$

$$= -1\left[\frac{1}{\frac{1}{4}} + \frac{1}{\frac{9}{4}} + \frac{1}{\frac{25}{4}} + \ldots\ldots\right]$$

$$= -4\left[\frac{1}{1} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots + \frac{1}{(2N-1)^2}\right]$$

$\Rightarrow$ (a)

Section II

10. $b_1 = a_1$

$b_2 = a_1 + a_1 r$, $b_3 = a_1 + a_1 r + a_1 r^2$

$b_4 = a_1 + a_1 r + a_2 r^2 + a_3 r^3$

They are neither in A.P. nor G.P

$\therefore$ Statement 1 is true

b_1, b_2, b_3, b_4 are not in H.P

$\therefore$ Statement 2 is false

$\therefore \Rightarrow$ (c)

11. $x^2 + 2px + q = 0$ and $ax^2 + 2bx + c = 0$ have common root

$\therefore \dfrac{\alpha^2}{2pc - 2pq} = \dfrac{\alpha}{aq - c} = \dfrac{1}{2b - 2ap}$

Again $x^2 + 2px + q = 0$ and $cx^2 + bx + a = 0$ have common root

$\dfrac{\beta^2}{2ap - 2bq} = \dfrac{\beta}{cq - a} = \dfrac{1}{2b - 2pc}$

By using statement (2) α, β are real

$\therefore (p^2 - q) > 0$ and $b^2 - ac > 0$

$\therefore (p^2 - q)(b^2 - ac) > 0$

$\therefore \Rightarrow$ (a)

12. Centre of the circle is at (–3, 5)

Radius = 2

If L_1 is a chord of the circle

$2 \times -3 + 3 \times 5 + p - 3 \neq 0$

$p + 6 \neq = \Rightarrow p \neq -6$

If L_2 is to be a diameter of the circle,

$2 \times -3 + 3 \times 5 + p + 3 = 0$

$p = -12$

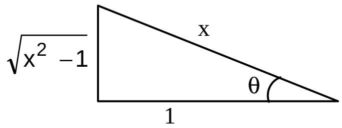
statement 2 is true

statement 1 is also true

But, it does not follow from statement 2

$\Rightarrow$ (b)

13.



$\dfrac{dy}{y\sqrt{y^2-1}} = \dfrac{dx}{x\sqrt{x^2-1}}$

$\sec^{-1} y = \sec^{-1} x + c$

$x = 2,\ y = \dfrac{2}{\sqrt{3}}$

$\sec^{-1}\dfrac{2}{\sqrt{3}} = \sec^{-1} 2 + c$

$\dfrac{\pi}{6} = \dfrac{\pi}{3} + c \Rightarrow c = \dfrac{\pi}{6} - \dfrac{\pi}{3} = \dfrac{-\pi}{6}$

$\Rightarrow \sec^{-1} y = \sec^{-1} x - \dfrac{\pi}{6}$

$y = \sec\left(\sec^{-1} x - \dfrac{\pi}{6}\right)$ — (1)

Statement 1 is true

Consider the relation

$\dfrac{1}{y} = \dfrac{2\sqrt{3}}{x} - \sqrt{1 - \dfrac{1}{x^2}} \qquad = \dfrac{2\sqrt{3}}{x} - \dfrac{\sqrt{x^2-1}}{x}$

$= \dfrac{2\sqrt{3} - \sqrt{x^2-1}}{x}$

$y = \dfrac{x}{2\sqrt{3} - \sqrt{x^2-1}}$

From (1)

$\dfrac{1}{y} = \cos\left(\sec^{-1} x - \dfrac{\pi}{6}\right)$

$= \cos\left(\sec^{-1} x\right)\cos\dfrac{\pi}{6} + \sin\left(\sec^{-1} x\right)\sin\dfrac{\pi}{6}$

$= \cos\left(\cos^{-1}\dfrac{1}{x}\right).\dfrac{\sqrt{3}}{2} - \dfrac{\sqrt{x^2-1}}{2}$

Statement 2 is false

Statement 1 is true

$\Rightarrow$ (c)

Section III

14. $f(x) = \dfrac{x^2 + ax + 1 - 2ax}{x^2 + ax + 1}$

$$= 1 - \frac{2ax}{x^2+ax+1}$$

$$f'(x) = \frac{\left(x^2+ax+1\right)(-2a)+2ax(2x+a)}{\left(x^2+ax+1\right)^2}$$

$$= \frac{-2ax^2-2a^2x-2a+4ax^2+2a^2x}{\left(x^2+ax+1\right)^2}$$

$$= \frac{2a\left(x^2-1\right)}{\left(x^2+ax+1\right)^2}$$

$$f''(x) = \frac{\left(x^2+ax+1\right)^2[4ax]-4a\left(x^2-1\right)\left(x^2+ax+1\right)(2x+a)}{\left(x^2+ax+1\right)^4}$$

$$f''(1) = \frac{(2+a)^2 4a}{(2+a)^4} = \frac{4a}{(2+a)^2}$$

$$f''(-1) = \frac{(2-a)^2(-4a)}{(2-a)^4} = \frac{-4a}{(2-a)^2}$$

$(2 + a)^2 f''(1) + (2 - a)^2 f''(-1) = 0$

$\Rightarrow$ (a)

15. $f'(x) = \dfrac{2a\left(x^2-1\right)}{\left(x^2+ax+1\right)^2}$

Since a > 0, $x^2 - 1$ is < 0

When $x \in (-1, 1)$

$\Rightarrow$ (a)

16. $g(x) = \displaystyle\int_0^{e^x} \frac{f'(t)}{1+t^2}\,dt$

$$\Rightarrow g'(x) = \frac{f'(e^x)}{1+(e^x)^2} \times e^x$$

$$= \frac{e^x}{1+(e^x)^2}\left\{\frac{2a(e^{2x}-1)}{\left(e^{2x}+ae^x+1\right)^2}\right\}$$

$\Rightarrow$ (b)

17. $\left(3\bar{i}+\bar{j}+2\bar{k}\right)\times\left(\bar{i}+2\bar{j}+3\bar{k}\right)$

= $C_6H_5\overset{*}{C}OCH_3$

$= -\bar{i}-7\bar{j}+5\bar{k}$

Unit vector $= \dfrac{1}{5\sqrt{3}}\left(-\bar{i}-7\bar{j}+5\bar{k}\right)$

$\Rightarrow$ (b)

18. Shortest distance

(–1, –2, –1) $\rightarrow$ point on L_1

(2, –2, 3) $\rightarrow$ point on L_2

$$\text{Shortest distance} = \frac{1}{5\sqrt{3}}\begin{vmatrix}3 & 0 & 4\\ 3 & 1 & 2\\ 1 & 2 & 3\end{vmatrix}$$

$$= \frac{3(-1)+4\times5}{5\sqrt{3}} = \frac{17}{5\sqrt{3}}$$

$\Rightarrow$ (d)

19. Equation of the plane is

$-1(x + 1) - 7(y + 2) + 5(z + 1) = 0$

$-x - 7y + 5z - 10 = 0$

$x + 7y - 5z + 10 = 0$

$$\text{Distance} = \frac{1+75+10}{\sqrt{75}} = \frac{13}{\sqrt{75}}$$

$\Rightarrow$ (c)

Section IV

20. $\begin{vmatrix}1 & 3 & -5\\ 3 & -k & -1\\ 5 & 2 & -12\end{vmatrix}$

$12k + 2 - 3(-36 + 5) - 5(6 + 5k) = 0$

$12k + 2 + 108 - 15 - 30 - 25k = 0$

$-13k + 65 = 0 \Rightarrow k = 5$

(a) $\rightarrow$ s

(b) $\rightarrow$ p, q

(c) $\rightarrow$ r

(d) $\rightarrow$ p, q, s

21.

(A) $y = \dfrac{x^2+2x+4}{x+2}$

$$y' = \frac{(x+2)(2x+2)-\left(x^2+2x+4\right)}{(x+2)^2}$$

$$= \frac{x^2+4x}{(x+2)^2}$$

$$y'' = \frac{(x+2)^2(2x+4)-\left(x^2+4x\right)2(x+2)}{(x+2)^4}$$

For extremum, $y' = 0 \Rightarrow x = 0, -4$

At x = 0, y''> 0 $\Rightarrow$ x = 0 gives a min. pt & min. value = 2

At x = –4, y'' < 0 $\Rightarrow$ x = –4 gives a max. pt & max value = –6

$\therefore \Rightarrow$ (r)

(B) (A + B) (A – B) = (A – B) (A + B)

$\Rightarrow$ AB = BA --------(1)

$(AB)^T = (-1)^k AB$

$\Rightarrow B^T A^T = (-1)^k BA$ (using 1)

$-BA = = (-1)^k BA$

(because B is skew symmetric and A is symmetric)

$\Rightarrow$ k is an odd integer.

$\therefore$ k is 1 or 3

$\therefore \Rightarrow$ (q), (s)

(C) $a = \log_3 \log_3 2 \Rightarrow 3^a = \log_3 2$

$\Rightarrow 3^{-a} = \log_2 3$

We have

$1 < 2^{-k+3^{-a}} < 2$

$\Rightarrow$ $0 < -k + \log_2 3 < 1$

$\Rightarrow$ $\log_2 3 - 1 < k < \log_2 3$

$\Rightarrow$ Integer value that k takes is 1.

$\Rightarrow$ (r), (s)

(D) $\sin\theta = \cos\varphi = \sin\left(\frac{\pi}{2} - \varphi\right)$

$\Rightarrow \theta = n\pi + (-1)^n\left(\frac{\pi}{2} - \varphi\right)$

For n = 1, we get $\frac{\theta - \varphi - \frac{\pi}{2}}{\pi} = 0$

For n = 2, we get $\frac{\theta + \varphi - \frac{\pi}{2}}{\pi} = 2$

$\Rightarrow$ (p), (r).

22.

(A) ENDEA is considered as 1 letter

Remaining letters are E, N, O, L

So 4 + 1 = 6 letters $\Rightarrow$ 5!

$\Rightarrow$ (p)

(B) E_ _ _ _ _ _ _ E

The remaining letters are 2N, E, D, A, O, L

Required number of permutations = $\frac{7!}{2!}$

$= 21 \times 5!$

$\Rightarrow$ (s)

(C) D, L, N can occur only in the first four places

$\Rightarrow$ D, L, N, N occurs in the first four places

No. of ways = $\frac{4!}{2!}$ = 12

Remaining are 3E, A, 0, fill in the 5 places

No. of ways = $\frac{5!}{3!}$ = 20

Total no. of ways = $(5 \times 4 \times 3 \times 2) \times 2$

$= 2 \times 5!$

$\Rightarrow$ (q)

(D) × _ × _ × _ × _ × (9 places: – – – – – – – – –)

5 odd positions

A, E and O occur only in odd positions

$\therefore$ A, E, E, E, O occupy 5 places = $\frac{5!}{3!}$ = 20

Remaining 4 places are filled by

N, N, L, D in $\frac{4!}{2!}$ ways = 12

$= 2 \times 5!$

$\Rightarrow$ (q)

PART II

23	24	25	26	27	28	29	30	31	32
C	**A**	**A**	**C**	**D**	**B**	**A**	**A**	**B**	**B**

33	34	35	36	37	38	39	40	41
D	**B**	**C**	**A**	**B**	**C**	**D**	**D**	**C**

42	43	44
A – p	**A – p, q, r, s**	**A – q**
B – q, r, s	**B – q**	**B – p, r**
C-s	**C-p, q, r, s**	**C – p, s**
D-q	**D-p, q, r, s**	**D – q, s**

Section I

23. $F = \frac{1}{4\pi\varepsilon_0}\frac{q/3 \times 2q/3}{\left(\sqrt{3}\,R\right)^2}$

24. $\lambda_1 = \frac{1}{4}\lambda_2$

25. P moves up implies direction $\hat{j}$

26. $\frac{1}{2}kx^2 = \frac{1}{2}4\,ky^2$

27. $v^2 = u^2 - 2\,gh$; $u^2 = 5\,gR$

$\Rightarrow v^2 = \frac{u^2}{4} \Rightarrow h = \frac{15}{8}R$

28. $P_1 = \frac{4T}{R}; P_2 < \frac{4T}{R}$

air flowing from 1 to 2 equalizing pressure.

29. $\frac{3\lambda}{4} = 0.75 \Rightarrow \lambda = 1$ m

f = 340 Hz; T increases f increases; beat decreases $\Rightarrow$ n = 340 + 4

30. $C = \frac{\varepsilon_0 A}{(d-x)+\frac{x}{K}}$

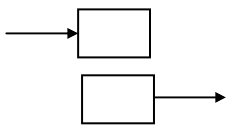
$x = \frac{d}{3}vt$

31. Only region I and IV are to be reckoned for TIR.

Section II

32. Solution not required

33.



34. For earth radius is large; never zero potential.

35. Solution not required

Section III

36. $E = \frac{1}{4\pi\varepsilon_0}\frac{Ze}{R^2}$

37. $\rho = d\left(1-\frac{r}{R}\right)$

$\int \rho 4\pi r^2 dr = Ze$

38. Standard E variation for uniform sphere

39. $2\,kxR = I\alpha = \frac{3}{2}MR^2\frac{a}{R}$

$Ma = \frac{4}{3}kx$

40. $\omega = \sqrt{\frac{4k}{3M}}$

41. $f = I_{CM}\alpha = \frac{Ma}{2} = \frac{2}{3}kx$

$\frac{2}{3}kA = \mu mg$

$2\frac{1}{2}kA^2 = \frac{1}{2}I\omega^2$

Section IV

42. Solution not required

43. Solution not required

44. Solution not required

PART III

45	46	47	48	49	50	51	52	53	54
D	**A**	**C**	**C**	**B**	**C**	**B**	**B**	**D**	**D**

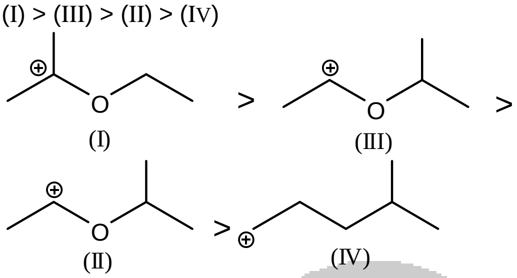
55	56	57	58	59	60	61	62	63
A	**A**	**A**	**B**	**A**	**D**	**B**	**A**	**D**

64 65 66

A – r, s	**A – p**	**A – q**
B – p, q	**B – q**	**B – p, q, r**
C – p, q, r	**C – p, r**	**C – p, q, r**
D –p	**D –s**	**D –q**

Section I

45. (D)
(I) > (III) > (II) > (IV)



46. (A)

Cellulose has a β-glycosidic linkage. While structures (A) and (B) have β glycosidic linkages, only the structure (A) is a triacetate.

47. $C_6H_5-\overset{O}{\overset{\|}{C}}-\overset{*}{C}H_2-\overset{O}{\overset{\|}{C}}-OH$ is a β keto acid which undergoes readly decarboxylation to give $C_6H_5CO\overset{*}{C}H_3$ which is (E). (E) undergoes iodoform reaction to give (F) which is C_6H_5COONa and (G) which is $\overset{*}{C}HI_3$.

48. (C)
CuF_2 is coloured because Cu^{2+} with d^9 configuration is the cation.

49. (B)
$[Ni(CO)_4]$ – sp^3
$Ni(CN)_4^{2-}$ – dsp^2

50. (C)
Tetraammine copper (II)
Tetrachloronickelate (II)

51. (B)
1 mole of hydrogen = 2 equivalents
0.1 mole of hydrogen = 0.02 equivalents
Current required = 0.02 F
= 0.02 × 96500 C

Time (Sec) $= \dfrac{0.02 \times 96500}{10 \times 10^{-3}}$
$= 19.3 \times 10^4$

52. (B)

53. (D)
$MX : K_{sp} = S^2 \qquad S = \sqrt{4 \times 10^{-8}}$

$MX_2 : K_{sp} = 4S^3 \qquad S = \sqrt[3]{\dfrac{3.2 \times 10^{-14}}{4}}$

$M_3X : K_{sp} = 27S^4 \qquad S = \sqrt[4]{\dfrac{2.7 \times 10^{-15}}{27}}$

$MX > M_3X > MX_2$

54. (D)
Statement (1) is not correct as an orange red dye is formed. Statement (2) is true because the red colour is due to extended conjugation

55. (A)
Statement (1) is true statement (2) is true and is correct explanation for statement (1).

56. (A)
Statement (1) is true statement (2) is true and Is the correct explanation of statement (1).

57. (A)

58. (B)

$$C_6H_5-\overset{O}{\overset{\|}{C}}-CH_3 + PhCH_2MgBr \xrightarrow{\text{Work up}} C_6H_5-\underset{OH}{\overset{CH_3}{C}}-CH_2C_6H_5$$
(H)

59. (A)

$$C_6H_5-\underset{OH}{\overset{CH_3}{C}}-CH_2C_6H_5 \xrightarrow{-H_2O} C_6H_5-\overset{CH_3}{C}=CH-C_6H_5$$
(I)

60. (D)

J = $C_6H_5C(=O)H$

K = $C_6H_5COCH_3$
L = $C_6H_5COO^-K^+$

61. (B)
Effective number of particles in HCP =
$\frac{1}{6} \times 12 + \frac{1}{2} \times 2 + 3 = 6$

62. (A)
Volume of Unit cell = $6 \times \frac{\sqrt{3}}{4} (2r)^2 \times 4r\sqrt{\frac{2}{3}}$
$= 24\sqrt{2}\, r^3$

63. (D)
PF = 0.74
VF = 0.26

64. (A) $\rightarrow$ R, S
(B) $\rightarrow$ P, Q
(C) $\rightarrow$ P, Q, R
(D) $\rightarrow$ P

65. (A) $\rightarrow$ P
(B) $\rightarrow$ Q
(C) $\rightarrow$ P, R
(D) $\rightarrow$ S

66. (A) $\rightarrow$ Q
(B) $\rightarrow$ P, Q, R
(C) $\rightarrow$ P, Q, R
(D) Q